

TWO NEW SUBGENERA OF *PTEROSTICHUS* BONELLI
FROM WESTERN UNITED STATES, WITH NOTES ON
CHARACTERISTICS AND RELATIONSHIPS OF THE
SUBGENERA *PARAFERONIA* CASEY AND
FERONINA CASEY (COLEOPTERA: CARABIDAE)

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INTRODUCTION

The North American fauna of the tribe Pterostichini is varied and taxonomically complex. Consequently, the relationships of the various elements are hardly understood. As knowledge of this tribe increases, many of the genus-group taxa presently recognized will be modified in composition, and many will be differently ranked. In particular, the organization of the largest genus of the tribe, *Pterostichus* Bonelli, will be altered.

In the course of a revision of the North American species of the subgenus *Cryobius* Chaudoir, I had occasion to examine groups which contained species similar to those included in *Cryobius*. Among these were the subgenera *Paraferonia* Casey and *Feronina* Casey. This paper deals with the composition of these groups and their relationships, judged on the basis of external morphology of the adults, and, in particular, on the basis of the structure of the male genitalia.

This study is a contribution to the task of defining the North American subgenera of *Pterostichus*.

For purposes of discussion, I will refer to these groups collectively as the "*Feronina* complex," and add to this the species *Pterostichus shulli* Hatch.

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CLASSIFICATION AND DESCRIPTIONS

The "*Feronina* complex." The species included share the following characteristics: generic characteristics of *Pterostichus*; size small (total length less than 11.5 mm); articles 1 and 2 of middle and hind tarsus

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with a longitudinal ridge on outer side, article 5 with ventral surface glabrous; plica of elytron normally developed; scutellar stria present, interval 3 with two or three setigerous punctures; metepisternum with anterior margin as long as lateral margin, hind wings reduced to short stubs. The male genitalia are varied, but the internal sac does not possess large, band-like sclerites. All of the species inhabit forested, montane regions, and are found in damp situations. They do not occur in the alpine zone, nor are they northern: for example, none are known from Canada or Alaska. They are rarely encountered by collectors.

The species of *Cryobius* are distinguished from the members of this complex by the setae on the ventro-lateral margins of the claw-bearing articles of the tarsi, and by the band-like sclerite or sclerites of the internal sac of the male genitalia. The species are arctic-alpine in distribution.

Historical aspects. LeConte (1873:306) placed the species *lubricus* LeConte, 1852, in a group by itself (division 3A), within the genus *Pterostichus*, thereby showing implicitly that this species was without close relatives.

Schaeffer (1910: 393-394) described the species *palmi* from North Carolina, declaring it to be very similar to *lubricus*, but because of a difference in number of elytral punctures, he implicitly erected a new group for *palmi*.

Casey erected the genus *Feronina* for *palmi* (1918: 365), and the genus *Paraferonia* for *lubricus* (1918:376), recognizing formally the distinctiveness of these species.

Van Dyke (1926) described the species *Pterostichus* (*Cryobius*) *pacificus*, and *P. (C.) lanei*. Subsequently (1943:23), he changed the name of *pacificus* to *humidulus*, and placed this species and *lanei* in the subgenus *Feronina*.

Csiki (1930: 675 and 677) changed the status of *Feronina* and *Paraferonia* to that of a section of the subgenus *Pterostichus*.

Hatch (1949: 81) described the species *Platysma* (*Cryobius*) *shulli*. In his treatment of *Pterostichus* (1953:114), Hatch returned *humidulus* Van Dyke to *Cryobius*, but retained *lanei* in *Feronina*. This arrangement was made on the basis of form of the posterior lateral impressions of the pronotum: single and narrow in *Feronina*, double in *Cryobius*. However, both conditions occur in *Cryobius*, so this difference is hardly diagnostic.

In summary, the arrangement of these species in 1953 was:

Subgenus *Pterostichus* Bonelli, 1809

Section *Paraferonia* Casey, 1918

lubricus LeConte, 1852

Subgenus *Feronina* Casey, 1918

palmi Schaeffer, 1910

lanei Van Dyke, 1926

Subgenus *Cryobius* Chaudoir, 1838

humidulus Van Dyke, 1943

shulli Hatch, 1949

Ball (1960:124) following Van Dyke, included *lanei* and *humidulus* in *Feronina*, and changed the rank of *Paraferonia* to subgenus, but neglected to consider *shulli*. Now, these classifications are in part supported by genitalic and other characteristics, but in the main the genitalic characteristics suggest a different arrangement.

The eastern species, *lubricus* and *palmi*, although more similar to one another than to any other member of the complex, seem to be too different to be included in the same subgenus. The western species, *lanei* and *humidulus*, are also similar to one another in structure of the male genitalia, but they are radically different from *palmi* (type species of *Feronina*), and from the species of *Cryobius*. They cannot be included in any subgenus known to me, so a new one will be proposed.

The species *shulli* Hatch, superficially similar to the above western species and to the species of *Cryobius*, cannot be placed with either group on the basis of genitalic characteristics, so I will propose a new subgenus for this species. These groups, *Paraferonia*, and *Feronina* are characterized below.

Subgenus *Paraferonia* Casey

This subgenus includes the species *P. lubricus* LeConte, 1852.

External characteristics. A member of the "Feronia complex." Eyes rather small (length of temple/length of eye: 0.31-0.43). Mandibles modified: left mandible with a dorsal protuberance, scrobe extending to ventral surface anteriorly; right mandible with a transversely directed groove in dorsal surface. Pronotum with posterior lateral impressions on each side single, more or less linear, and deep; posterior-lateral setigerous punctures on lateral bead; prosternum between front coxae with apex finely margined. Dorsal surface of elytra strongly iridescent; striae shallow, 5 faint, 6 and 7 almost effaced, except at apex; interval 3 with three setigerous punctures. Abdominal sternum 6 of male with a prominent projection medio-ventrally.

Male genitalia. Median lobe cylindrical, basal portion forming an acute angle with shaft (fig. 1A), apical portion in ventral aspect abruptly narrowed before apex (fig. 1B), apex a narrow lobe. Left paramere very broad, apex rounded (fig. 1C). Right paramere about one-half the length of median lobe, with apical portion sharply recurved, apex broadly rounded (fig. 1D). Internal sac emerging on left side of median lobe, extended dorsally when everted; two medial sclerites (figs. 1E and F), gonopore terminal.

Material examined. Three males, five females of *Pterostichus lubricus* from the following localities: NORTH CAROLINA. Balsam Gap, Balsam Mts.; Highlands; Linville; and Tryon (Museum of Comparative Zoology); Devil's Courthouse, Balsam Mts., Haywood Co. (G. E. Ball Coll.). TENNESSEE. Monroe Co.; Unaka Mts. (Museum of Comparative Zoology). "SOUTHERN STATES." A single male from the LeConte Collection, labelled as follows: orange disc; *lubricus* 2.

Subgenus *Feronina* Casey

This subgenus includes a single species, *Pterostichus palmi* Schaeffer, 1910.

External characteristics. A member of the "Feronina complex." Eyes markedly reduced (length of temple/length of eye: 0.60-0.74). Mandibles average for *Pterostichus*, without special grooves or protuberances, scrobe of left mandible completely

separated from ventral surface by a distinct ridge. Pronotum with posterior-lateral impressions on each side single, narrow, linear; posterior lateral setigerous punctures on lateral bead; tip of prosternum between front coxae margined or not. Elytra iridescent, striae of moderate depth, all equally impressed; interval 3 with two setigerous punctures. Male with sternum 6 of abdomen without a median ventral protuberance.

Male genitalia. Median lobe cylindrical, with basal portion meeting shaft at an obtuse angle (fig. 2A); apical portion in ventral aspect tapering gradually, apex broadly rounded (fig. 2B). Left paramere broad, apex subtruncate (fig. 2C). Right paramere slender, elongate, with parallel sides, over one half the length of median lobe (fig. 2D). Internal sac extended dorsally when everted, with two sclerites near gonopore (fig. 2E); gonopore terminal.

Material examined. One male, three females of *Pterostichus palmi* from the following localities: VIRGINIA. Stone Creek, Lee Co.; and Pennington Gap (Museum of Comparative Zoology). NORTH CAROLINA. Mt. Mitchell (Museum of Comparative Zoology); Fork Ridge, BRP 445 (D. R. Whitehead Coll.).

Subgenus *Pseudoferonina* Ball, NEW SUBGENUS

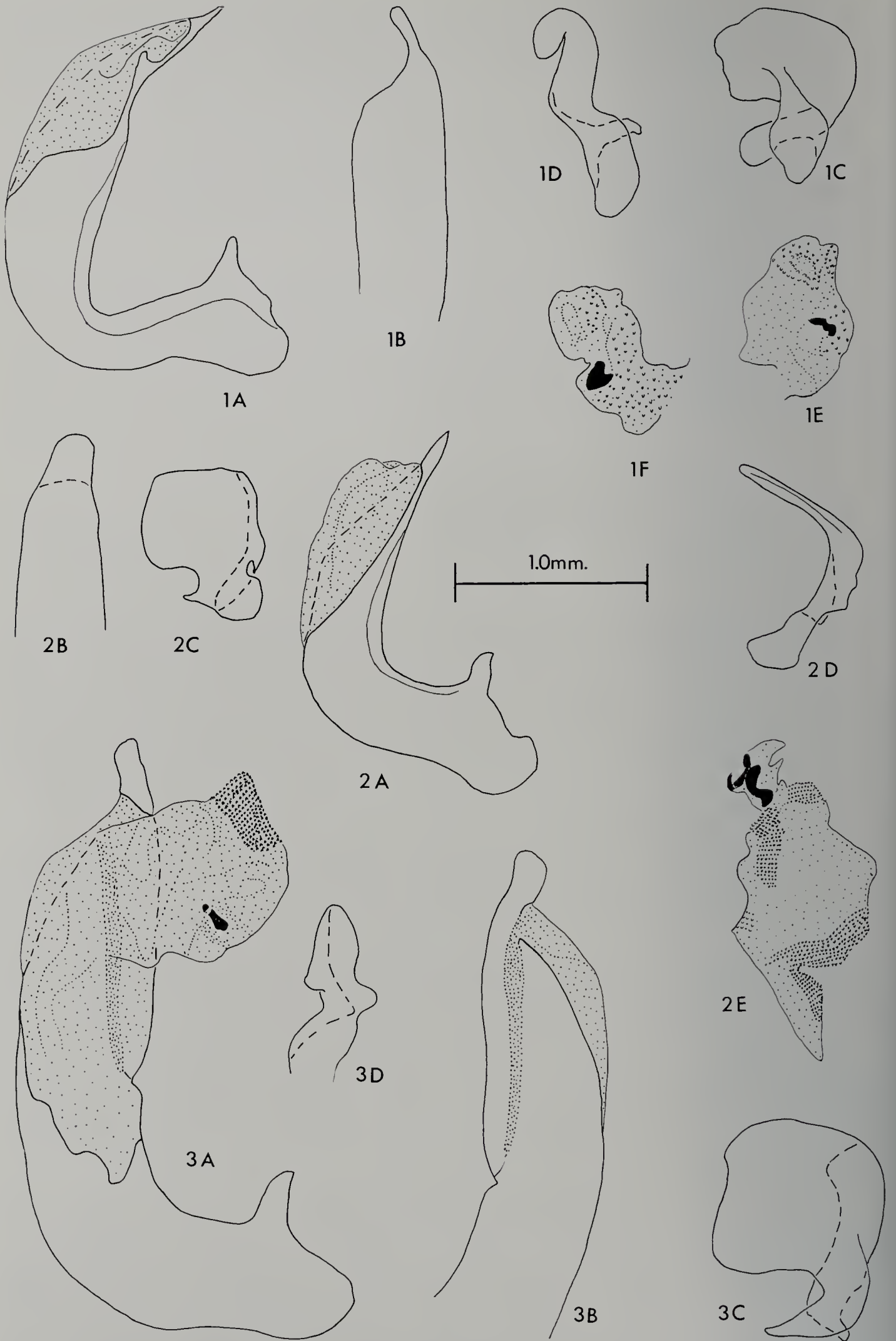
This subgenus includes *humidulus* Van Dyke; and *lanei* Van Dyke, here designated as TYPE-SPECIES. The derivation of the name is obvious.

External characteristics. Member of the "*Feronina* complex." Eyes of about average size (length of temple/length of eye: 0.20-0.30). Mandibles average for *Pterostichus*, without special grooves or protuberances; scrobe of left mandible completely separated from ventral surface by a ridge. Pronotum with posterior-lateral impressions on each side basin-like, single, and impunctate (*lanei*), or double and punctate (*humidulus*); posterior lateral setigerous punctures not on lateral bead; tip of prosternum between front coxae not margined. Elytra feebly iridescent, striae of moderate depth (*lanei*) or shallow (*humidulus*), all of about equal depth for a given specimen; interval 3 with two setigerous punctures. Sternum 6 of male without a median ventral protuberance.

Male genitalia. Median lobe compressed, basal portion forming an obtuse angle with shaft (figs. 3A and 4A); shaft with apical portion separated from basal portion by a lightly sclerotized or membranous diagonal strip (figs. 3B and 4B); apex broad (*lanei*) or narrow (*humidulus*). Left paramere broad, apex rounded, more (*humidulus*, fig. 4C) or less (*lanei*, fig. 3C). Right paramere short, about one-third of the length of median lobe (figs. 3D and 4D—note, both damaged in dissection). Internal sac (studied in detail for *lanei* only) protruding ventrally when everted, with a single sclerite near gonopore; gonopore basal, with a large membranous lobe apically (fig. 3A); internal sac ventro-apically with a large microtrichial field.

Notes. The characteristics of the internal sac and median lobe of this subgenus are most peculiar. Usually, in carabids, the gonopore is terminal in position, not basal, and in the everted position, the internal sac is directed dorsad rather than ventrad. The shaft of the median lobe in carabids is usually completely sclerotized on the ventral surface.

In *lanei*, the membranous strip seems to serve as a hinge, the apical part of the shaft moving on the basal portion. I am not prepared to speculate on the functional aspects of these interesting modifications, but will point out that a rudimentary joint in the form of a deep notch toward the apex and on the right side of the median lobe is present in *Pterostichus (Pherypes) tarsalis* LeConte. Perhaps, then, *Pherypes* and *Pseudoferonina* are more closely related than we have suspected previously.



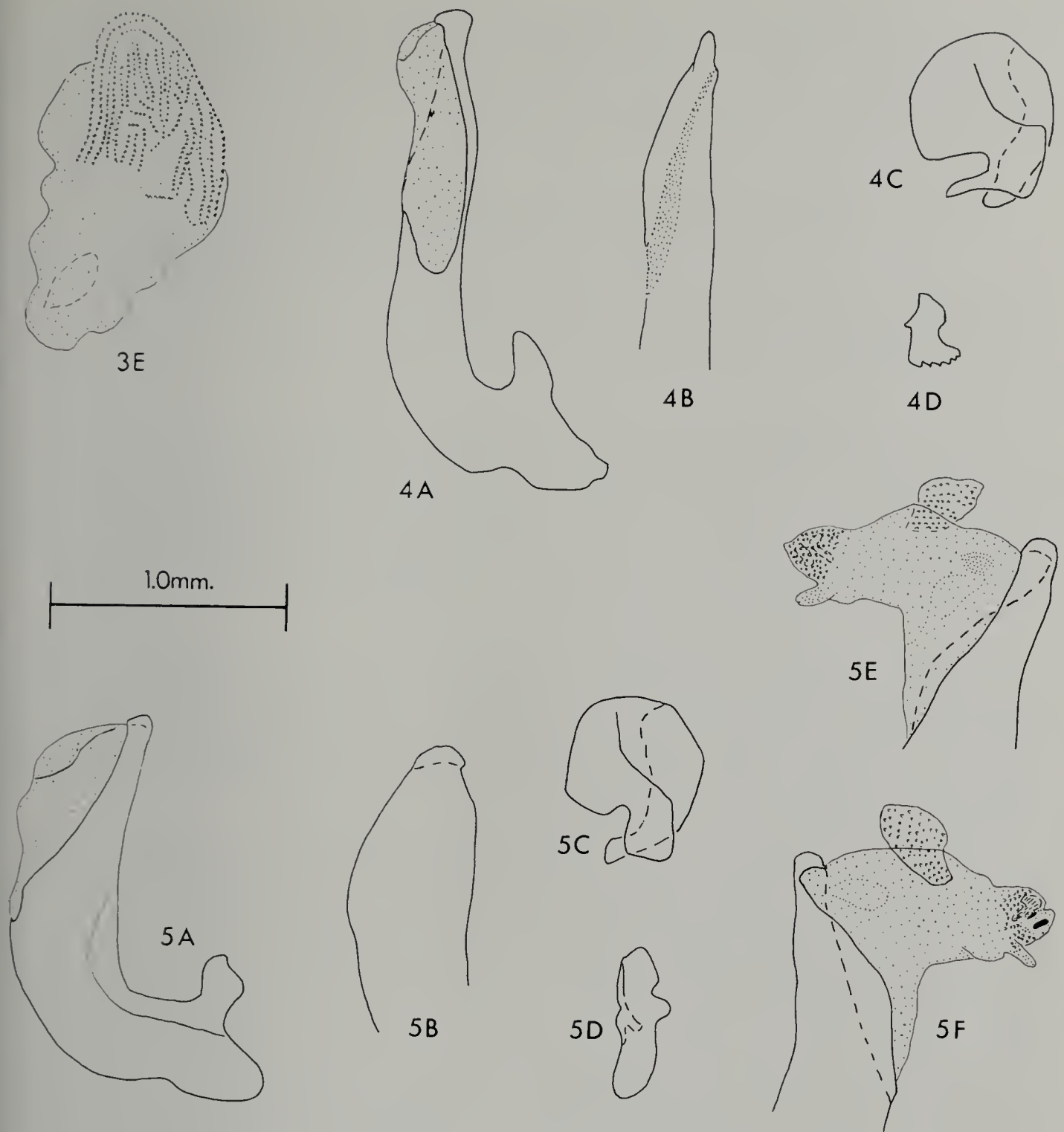


FIGURE 1, Male genitalia of *Pterostichus lubricus* LeConte, Tryon, North Carolina (MCZ). A—Median lobe, left lateral aspect. B—Median lobe, apical portion, ventral aspect. C—Left paramere, ventral aspect. D—Right paramere, ventral aspect. E—Internal sac, everted, left lateral aspect. F—Internal sac, everted, ventral aspect.

FIGURE 2, Male genitalia of *Pterostichus palmi* Schaeffer, Fork Ridge, North Carolina (Whitehead). A—Median lobe, left lateral aspect. B—Median lobe, apical portion, ventral aspect. C—Left paramere, ventral aspect. D—Right paramere, ventral aspect. E—Internal sac, right lateral aspect.

FIGURE 3, Male genitalia of *Pterostichus lanei* Van Dyke. A—Median lobe, left lateral aspect, with internal sac everted. B—Median lobe, right lateral aspect. C—Left paramere, ventral aspect. D—Right paramere, ventral aspect. E—Internal sac, everted, ventral aspect.

FIGURE 4, Male genitalia of *Pterostichus humidulus* Van Dyke. A—Median lobe, left lateral aspect. B—Median lobe, apical portion, ventral aspect. C—Left paramere, ventral aspect. D—Right paramere, apical portion, ventral aspect.

FIGURE 5. Male genitalia of *Pterostichus shulli* Hatch. A—Median lobe, left lateral aspect. B—Median lobe, apical portion, ventral aspect. C—Left paramere, ventral aspect. D—Right paramere, ventral aspect. E—Internal sac, everted, left lateral aspect. F—Internal sac everted, right lateral aspect.

Material examined. *Pterostichus lanei* Van Dyke, male, holotype, Wawawai, Washington. *Pterostichus humidulus* Van Dyke, one male, Cannon Beach, Oregon. Both specimens are in the collection of the California Academy of Sciences.

Subgenus *Melvilleus* Ball, NEW SUBGENUS

This group contains the single species, *Pterostichus shulli* Hatch, 1949, which is here designated as TYPE-SPECIES.

The name of the subgenus is derived from the given name of the describer of *shulli*, Melville H. Hatch.

External characteristics. Member of the "*Feronina* complex." Eyes of average size (length of temple/length of eye: 0.25). Mandibles average for *Pterostichus*, without special grooves or protuberances, scrobe of left mandible completely separated from ventral surface by a ridge. Pronotum with posterior lateral impressions on each side double; posterior lateral setigerous punctures not on lateral bead; apex of prosternum between front coxae not margined. Elytra iridescent, striae shallow, all about equally impressed, interval 3 with two setigerous punctures; sternum 6 of abdomen of male without a protuberance.

Male genitalia. Median lobe more or less cylindrical, not compressed, basal portion short, forming with shaft an obtuse angle (fig. 5A); apex in ventral aspect broadly rounded, asymmetrical (fig. 5B). Left paramere with apex broadly rounded (fig. 5C). Right paramere short, apical margin subtruncate, less than half the length of the median lobe (fig. 5D). Internal sac extended dorsally in everted position, with a large lobe toward apical margin, and a finger-like projection and two small sclerites near gonopore (figs. 5E and F).

The species *shulli* is most similar to the species of *Pseudoferonina*, but the males are readily separated on the basis of the genitalic characteristics described above. The diagnostic external characteristics are: *shulli*, palpi and antennae rufous, posterior lateral impressions of pronotum punctate, posterior lateral angles of pronotum obtuse, sides curving out almost directly from base, total length less than 10 mm.; *humidulus*, palpi and antennae rufous, posterior-lateral impressions of pronotum punctate, hind angles of pronotum acute, sides sinuate in front of hind angles, total length less than 10 mm.; *lanei*, palpi and antennae black, posterior-lateral impressions of pronotum impunctate, total length greater than 10.5 mm.

Material examined. One male of *Pterostichus shulli* from Harvard, Idaho (California Academy of Sciences).

KEY TO NINE NORTH AMERICAN SUBGENERA OF PTEROSTICHUS BONELLI (Modified from Ball, 1960:78)

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|----------|---|-------------|
| 15 (14). | Left mandible swollen toward apex; right mandible with a transverse groove in dorsal surface; apex of prosternum between front coxae margined; elytra with dorsal surface iridescent----- | PARAFERONIA |
| | Left mandible not swollen toward apex; right mandible without a transverse groove in dorsal surface ----- | 16 |
| 16 (15). | Pronotum almost rectangular (slightly wider at base than at apex), sides not sinuate posteriorly ----- | ABACIDUS |
| | Pronotum subcordate, at least narrowed posteriorly, base and apex subequal in width ----- | 17 |

17 (16).	Fifth article of hind tarsus with a row of setae on each ventro-lateral margin--	18
	Fifth article of hind tarsus without setae on each ventro-lateral margin-----	18A
18 (17).	Total length less than 10.0 mm.-----	CRYOBIUS (Part)
	Total length greater than 10.5 mm.-----	EUFERONIA (Part)
18A (17).	Range—western North America, west of Montana-----	18B
	Range—North America, east of Montana-----	18D
18B (18A).	Palpi and antennae black, posterior-lateral impressions of pronotum impunctate, total length 10.5 mm., or more-----	PSEUDOFERONINA (Part)
	Palpi and antennae rufous, pronotum with posterior-lateral impressions punctate, total length less than 10.0 mm.-----	18C
18C (18B).	Pronotum with hind angles obtuse, sides curving out almost directly from base -----	MELVILLEUS
	Pronotum with hind angles acute, sides subparallel in front of hind angles-----	PSEUDOFERONINA (Part)
18D (18B).	Pronotum with sides coarsely margined, posterior-lateral impressions on each side broad-----	18E
	Pronotum with sides finely margined, posterior-lateral impressions on each side linear-----	18F
18E (18D).	Elytron with two or three setigerous punctures on disc-----	EUFERONIA (Part)
	Elytron with four setigerous punctures on disc-----	REFONIA
18F (18D).	Eyes small, temples prominent-----	FERONINA
	Eyes normal, temples small-----	MONOFERONIA (Part)

RELATIONSHIPS

The eastern subgenera, *Paraferonia* and *Feronina*, are more closely related to one another than they are to the western groups. Further, the presence of a long right paramere allies them with other eastern subgenera, and suggests that they are derived from an eastern ancestor.

As mentioned previously, the subgenus *Pseudoferonina* shows some affinity with the western *Pherypes*. *Melvilleus*, on the other hand, does not appear to be closely related to any other subgenus of *Pterostichus*.

If the facts are correctly interpreted, the similarities shared by the eastern and western species of the "*Feronina* complex" are the result of parallelism, or convergence, or of the retention of characteristics from a remote common ancestry—characteristics that are at most indicative of patristic rather than cladistic affinity (Cain and Harrison, 1960).

Finally, I want to consider in a general way the relationships of the flightless, montane subgenera of *Pterostichus* of temperate eastern and western North America. There are no such subgenera occurring in both areas. (Lindroth has indicated in a personal communication that the species *P. adoxus* Say, 1825, assigned to the subgenus *Hypherpes*, is not related to the western members of this group.) This suggests that there has been no recent interchange. The east is very rich in distinct, endemic subgenera, while the west has a less diverse fauna. Probably the history of these groups is intimately tied to that of the Arcto-Tertiary flora. However, more data on relationships of the subgenera of *Pterostichus* are required before it will be profitable to pursue this question further.

SUMMARY

1. Two new subgenera of *Pterostichus* are proposed for species from western United States, and are characterized: *Pseudoferonia*, type-species *Pterostichus lanei* Van Dyke; and *Melvilleus*, type-species *Pterostichus shulli* Hatch.

2. The species of the monotypic subgenera *Paraferonia* Casey and *Feronina* Casey are characterized.
3. The male genitalia of the species of the subgenera mentioned above are illustrated.
4. The relationships of these subgenera are discussed, and it is concluded that the similarities among these groups are not the result of direct common ancestry.
5. The relationships of the montane, flightless *Pterostichus* faunas of eastern and western North America are discussed briefly. No subgenera are shared, so it is concluded that the relationships are at least pre-Pleistocene.

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